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Genetic Divergence In Sorghum Hybrids

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ABSTRACT

Genetic divergence in 34 genotypes of sorghum (10 parents and their 8 hybrids with their F_1, F_2 and F_3 generations) was studied taking seven characters, using Mahalanobis D^2 statistics. All genotypes were grouped in 12 clusters. No specific distribution of parents and their F_1 hybrids in the clusters was observed, however, in their segregating generations, they were grouped according to their male parents. The parents and their F_1s exhibited greater diversity which got sinked during selfing suggesting that diversity can be created by hybridization but the selfing progenies do not exhibit enough diversity. Yield per plant, number of leaves and days to maturity contributed maximum towards genetic diversity.

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INTRODUCTION

For the development of vigorous and widely adopted varieties/hybrids, more diversed parents are utilised in the breeding programme. To determine the divergence in the material, criteria of geographical diversity alone can not be considered as an index of genetic diversity since a number of studies in various crops (Timothy, 1963 in maize; Murty *et al.*, 1965 in brassica; Murty and Anand, 1966 in linseed; Singh and Bains, 1968 in cotton; Trehan *et al.*, 1974 in sesamum; and Malhotra *et al.*, 1974 in green gram) have revealed no such association and Mahalanobis D^2 is to be used for determining the relative contribution of each of the character to total diversity. Studies on divergence in sorghum have been reported by Murty and Arunachalam (1966) and Arunachalam and Ram (1967) but they are confined to varieties only and as such no information is available on hybrids though a number of hybrids for commercial cultivation have been released. Attempts were, therefore, made to conduct a study on eight hybrids, their F_2 and F_3 generations alongwith their parents to estimate the degree of genetic divergence existing among parents and their hybrids at different levels of heterozygosity.

MATERIALS AND METHODS

Thirty four genotypes consisting three generations (F_1, F_2, and F_3) of 8 sorghum hybrids (CSH-1, CSH-2, CSH-3, CSH-4, CSH-5, CSH-6 as well as two experimental hybrids-3660 A × CS 3541 and 3660 A × CS 3687) alongwith their 10 parents were grown in randomised block design, replicated three times during *kharif* 1974 at

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Agricultural Research Station, Vallabhanagar, University of Udaipur, Rajasthan. The material was planted in 5 m row length comprising single row for parents and F_1 hybrids, and 20 rows for F_2 and F_3 generations per plot. Observations were recorded for 10 plants of parents and F_1 and 30 plants of F_2 and F_3 for number of leaves (X_1), length of secondary branch (X_2), number of secondaries (X_3), number of whorls (X_4), days to maturity(X_5), test weight(X_6) and yield per plant(X_7).

Genetic divergence was estimated through Mahalanobis D^2 as explained by Rao (1952). Estimation of D^2 values were preceded with highly significant, value (at 231 d.f.=344.362**) for Walks lambda criteria. In all possible combinations 561 D^2 values were computed. Clusters were formed with small D^2 values as suggested by Tochar method (Rao, 1952). Efforts were made to form clusters such that intra cluster values were always smaller than inter cluster values. Criteria of characters towards genetic diversity was estimated as number of times the concerned character caused maximum genetic divergence.

RESULTS AND DISCUSSIONS

D^2 values were used in formulating clusters of similar genotypes. Out of 34 genotypes, 28 entered in six clusters, while remaining six (three parents and three F_1) could not be clustered in any group (Table 1). Cluster I was

TABLE 1

Cluster composition in terms of genotypes.

Cluster	*Parents*	*F_1*	*F_2*	*F_3*
I	1036 A, CS 3541	—	CSH-4	CSH-2
			3660 A x CS 3541	CSH-3
				CSH-4
II	2077 A, IS 3691	—	—	3660 A
	Swarna, CS 3687			x
				CS3541
III	IS 84	CSH-6	—	CSH-1
				CSH-5
				CSH-6
IV	—	CSH-1	CSH-1	—
			CSH-5	
			CSH-6	
V	—	CSH-5		
		3660 A x CS 3541	—	—
		3660 A x CS 3687		
VI	—	—	CSH-2	3660 A
			CSH-3	x
			3660 A x CS 3687	CS 3687
VII	CK 60 A	—	—	—
VIII	2219 A	—	—	—
IX	3660 A	—	—	—
X	—	CSH-2	—	—
XI	—	CSH-3	—	—
XII	—	CSH-4	—	—

TABLE 2

Inter and intra cluster D^2 values for sorghum.

Cluster	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*	*XI*	*XII*
I	10.500	16.907	29.000	22.750	34.142	16.214	35.000	62.357	31.428	68.000	101.000	27.714
	(3.20)	(4.11)	(5.38)	(4.77)	(5.84)	(4.02)	(5.91)	(7.89)	(5.60)	(8.20)	(10.05)	(5.26)
II		7.320	22.660	15.600	31.333	18.650	19.000	43.200	23.800	56.400	150.600	47.400
		(2.70)	(4.76)	(3.95)	(5.59)	(4.31)	(4.36)	(6.57)	(4.88)	(7.50)	(12.27)	(6.88)
III			14.400	16.500	48.666	31.005	31.800	28.400	52.600	122.600	171.000	36.000
			(3.79)	(4.06)	(6.97)	(5.56)	(5.64)	(5.33)	(7.25)	(11.14)	(13.07)	(6.00)
IV				6.76	26.500	25.125	22.000	30.500	29.500	108.750	162.000	36.250
				(2.60)	(5.14)	(5.01)	(4.69)	(5.52)	(5.43)	(10.43)	(12.72)	(6.02)
V					9.000	20.416	64.000	73.000	24.330	53.000	106.610	31.000
					(3.00)	(4.51)	(8.00)	(8.54)	(4.93)	(7.28)	(10.32)	(5.56)
VI						6.500	50.000	60.250	33.500	42.750	94.250	21.750
						(2.55)	(7.07)	(7.76)	(5.78)	(6.53)	(9.70)	(4.66)
VII							0.000	40.000	44.000	162.000	135.000	71.000
							(0.00)	(6.32)	(6.63)	(12.76)	(11.61)	(8.42)
VIII								0.000	64.000	180.000	225.000	66.000
								(0.00)	(8.00)	(13.41)	(15.00)	(8.12)
IX									0.000	91.000	159.000	74.000
									(0.00)	(9.53)	(12.60)	(8.48)
X										0.000	44.000	55.000
										(0.00)	(6.63)	(7.41)
XI											0.000	66.000
											(0.00)	(8.12)
XII												0.000
												(0.00)

Data in parenthesis show the corresponding square roots, i.e. 'D' values.

the largest and had 7 genotypes, while clusters from VII to XII had only one genotypes each. No particular distribution of parents and hybrids in the clusters was observed. Cluster II included 4 parents, while iv, v and vi included none. Out of eight F_1 hybrids three F_1s (CSH-5 and two experimental hybrids) which were having either male or female parents common, were grouped in cluster V but CSH-2, CSH-3 and CSH-4 could not be grouped in any cluster. The remaining two were grouped in cluster III and IV. It is rather surprising to note that except cluster III none of the F_1 hybrids were grouped in parental clusters and they form exclusively separate clusters, even in cluster III the one F_1 hybrid (CSH-6) which occurred in parental cluster do not belong to its original parental group cluster. Thus it clearly indicate that hybrids released so far are highly divergent among themselves, but why any of the F_1 hybrid could not be grouped in their parental clusters requires further investigations. Distribution of F_2 and F_3 genotypes was erratic and was not according to their F_1s but hybrids with common male parents were generally in the same clusters and their distribution was also limited to two to three clusters which suggested that divergence available in the F_1 hand undergone segregation due to selfing.

D^2 values (Table 2) ranged from 0.00 to 225.00. The distance was maximum between cluster VIII and XI (15.00) followed by VIII and X (13.41). The minimum distance was between the cluster III and IV (4.06). The intra group distance ranged from 0.00 to 3.20, maximum being in cluster VIII. Smaller intra cluster values were observed in cluster IV which had four genotypes. Excepting cluster VI all other clusters had greater intra cluster D^2 values than that of cluster II (the one which included 4 out of 10 parents) which further evidenced the diversity of the hybrids. Comparison of intra cluster values among genotypes indicated that three F_1s viz. CSH-2, CSH-3 and CSH-4 were more divergent from rest of the material and highest value was observed for CSH-2 (225), but first two of these were closest genotypes in F_3 as the lowest divergent value (2.30) was recorded for them.

Cluster means of D^2 values of different characters are presented in Table 3. Cluster III possessed high

TABLE 3

Mean Intra cluster D^2 values for different characters.

Cluster/ Character	*No. of Leaves* (*X1*)	*Length of second* (*X2*)	*No. of Secondaries* (*X3*)	*No. of whorls* (*X4*)	*Days to maturity* (**X5**)	*Test weight* (*X6*)	*Yield per plant* (*X7*)
I	2.619	1.472	1.280	0.613	1.527	1.301	2.710
II	0.706	0.283	0.426	1.232	0.586	1.872	2.203
III	2.418	1.850	0.482	2.019	0.696	1.295	5.651
IV	0.106	0.400	0.178	0.453	0.069	3.603	1.733
V	0.446	1.686	0.163	0.116	2.102	3.976	0.747
VI	1.020	1.768	0.766	6.076	1.567	2.900	5.583

mean values for yield per plant and length of secondaries, while more number of leaves and number of secondary branches were in cluster I, seed weight and maturity in cluster V and number of whorls in cluster VI.

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